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Mathematics 33

Diploma Examination Results
Examiners' Report for June 1996

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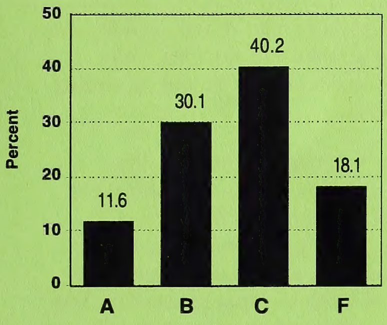
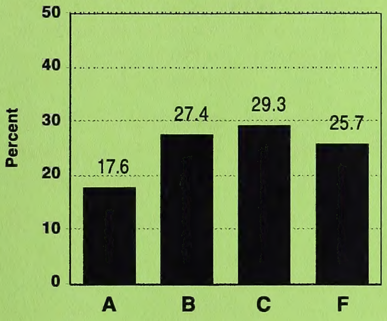
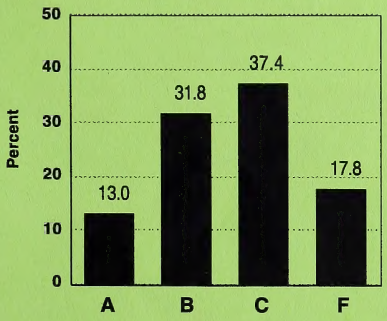

School-Awarded Mark


Diploma Examination Mark


Final Course Mark

The summary information in this report provides teachers, school administrators, students, and the general public with an overview of results from the June 1996 administration of the Mathematics 33 Diploma Examination. This information is most helpful when used with the detailed school and jurisdiction reports that have been mailed to schools and school jurisdiction offices. An annual provincial report containing a detailed analysis of the combined January, June, and August results is published each year.

Description of the Examination

The Mathematics 33 Diploma Examination consists of three question types: 37 multiple-choice questions worth 53%, 12 numerical-response questions worth 17%, and four written-response questions worth 30% of the total examination mark.

Achievement of Standards

The information reported is based on the final course marks achieved by 5 530 students who wrote the June 1996 examination.

- 82.2% of the 5 530 students achieved the acceptable standard (a final course mark of 50% or higher).
- 13.0% of these students achieved the standard of excellence (a final course mark of 80% or higher).

Approximately 49.9% of the students who wrote the June 1996 examination were females.

- 83.4% of the female population achieved the acceptable standard (a final course mark of 50% or higher).
- 14.4% of these students achieved the standard of excellence (a final course mark of 80% or higher).

Approximately 50.1% of the students who wrote the June 1996 examination were males.

- 80.9% of the male population achieved the acceptable standard (a final course mark of 50% or higher).
- 11.6% of these students achieved the standard of excellence (a final course mark of 80% or higher).

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Student Evaluation

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EDUCATION

Provincial Averages

- The average school-awarded mark was 61.4%.
- The average diploma examination mark was 61.6%.
- The average final course mark, representing an equal weighting of the school-awarded mark and the diploma examination mark, was 62.0%.

Of the 5 530 students who wrote the June 1996 examination, 206 had written at least one Mathematics 33 Diploma Examination previously.

Results and Examiners' Comments

This examination has a balance of question types and difficulties reflecting the philosophy of the Mathematics 33 Course of Studies. It was designed so that students who are achieving the acceptable standard in Math 33 can obtain a mark of 50% or higher. Students who are achieving the standard of excellence in Mathematics 33 should obtain a mark of 80% or higher. The student who is achieving the acceptable standard or the standard of excellence is expected to be able to achieve the curriculum standards identified in the *Mathematics 33 Information Bulletin, Diploma Examination Program*. At least 80% of the examination includes questions and tasks that students who achieve the acceptable standard should be able to complete successfully. The remaining part of the examination includes questions and tasks that students who achieve the standard of excellence should be able to complete successfully.

Future examinations will continue to focus on assessing students' understanding of mathematical concepts and on problem solving. Students will continue to be expected to solve problems, explain solutions, justify solutions, and/or apply concepts and procedures in the written-response section. The design of future field tests and examinations will include items that assess how well students have achieved the general learner expectations stated in the Mathematics 33 Course of Studies.

Blueprint

Question	Key	Difficulty	Rltns. & Fn.	Quad. Fn. & Eqns.	Powers & Rads.	Poly. & Rat. Exp.	Trig.	Stat.	Ann., Mtg. & Loans	Math Und.
MC 1	A	86.5	√							C
MC 2	D	71.3							√	P
MC 3	A	96.8							√	PS
MC 4	C	77.4						√		PS
MC 5	D	41.1	√							P
MC 6	D	51.5	√							C
MC 7	C	54.1	√							C
MC 8	B	70.9	√							C
MC 9	B	65.4		√						C
MC 10	A	74.5		√						C
MC 11	C	71.0		√						PS
MC 12	A	45.8		√						PS
MC 13	B	71.6			√					P
MC 14	D	64.5			√					P
MC 15	D	77.5			√					P
MC 16	A	40.0			√					P
MC 17	B	62.6			√					PS
MC 18	C	46.9				√				C
MC 19	B	49.1				√				P
MC 20	C	65.3				√				P
MC 21	C	47.1				√				P
MC 22	D	49.5				√				P
MC 23	B	69.0							√	P
MC 24	C	75.3	√							C
MC 25	A	69.1						√		PS
MC 26	D	44.2					√			PS
MC 27	A	63.5					√			PS
MC 28	C	56.4					√			PS
MC 29	B	69.4					√			P
MC 30	D	74.8	√							C
MC 31	D	40.7						√		C
MC 32	A	40.5		√						C

Question	Key	Difficulty	Rltns. & Fn.	Quad. Fn. & Eqns.	Powers & Rads.	Poly. & Rat. Exp.	Trig.	Stat.	Ann., Mtg. & Loans	Math Und.
MC 33	B	73.9					√			C
MC 34	A	59.2					√			PS
MC 35	B	82.6	√							C
MC 36	B	63.2		√						C
MC 37	C	50.2		√						C
NR 1	0.03	47.3	√							P
NR 2	1541	50.1							√	P
NR 3	4309	54.5							√	PS
NR 4	12.0	68.7	√							P
NR 5	4.0	43.8	√							P
NR 6	12.8	54.2	√							C
NR 7	2	72.7		√						C
NR 8	7	66.7			√					P
NR 9	3.5	56.1			√					P
NR 10	18.7	37.5					√			PS
NR 11	4.11	44.5			√					P
NR 12	70	68.2						√		P
WR 1	–	76.0						√		PCPS
WR 2	–	67.8			√					PCPS
WR 3	–	50.3				√				PCPS
WR 4	–	55.5					√			PCPS

Subtests

When analyzing detailed results, please bear in mind that subtest results **cannot** be directly compared. Some of the written-response questions involve concepts and problem solving procedures from more than one core content area.

Results are in average raw scores.

Machine scored: 29.8 out of 49

Written response: 13.3 out of 21

Course Content

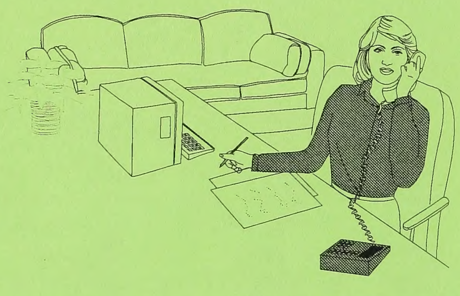
Rltns. & Fn.	Relations and Functions	7.5	out of	12
Quad. Fn. & Eqns.	Quadratic Functions and Equations	4.8	out of	8
Powers & Rads.	Powers and Radicals	7.5	out of	12
Poly. & Rat. Exp.	Polynomials and Rational Expressions	5.6	out of	11
Trig.	Trigonometry	6.3	out of	11
Stat.	Statistics	7.9	out of	11
Ann., Mtg. & Loans	Annuities, Mortgages, and Loans	3.4	out of	5

Mathematical Understandings*

- Procedural (P): 11.6 out of 20
- Conceptual (C): 10.8 out of 17
- Problem Solving (PS): 7.4 out of 12

*Refer to Appendix F of the 1995–96 *Mathematics 33 Information Bulletin, Diploma Examinations Program,* for an explanation of mathematical understandings.

CONSUMERISM
Dawn is a financial advisor. She constantly uses mathematics to make decisions related to her customers' investment and banking opportunities. Answer the following questions related to Dawn's experiences.



Use the following information to answer the next two questions.

Dawn organized an annuity for another customer. Starting in January, every six months, the customer will deposit $1 000 into an annuity that pays interest at 6% per annum, compounded semi-annually. Entries related to this annuity, for a 2-year period, are shown below.

Payment Period	Regular Payment	New Balance	Interest per Period	Final Balance
1	$1 000	$1 000.00	$1 000 × 0.03 = $30.00	$1 030.00
2	$1 000	$2 030.00	$2 030 × 0.03 = $60.90	$2 090.90
3	$1 000	$3 090.90	*i*	....
4	$1 000	....	*ii*	*iii*

3. The value of *i*, the interest for payment period 3, is

•A. $92.73
B. $91.80
C. $90.90
D. $90.30

Numerical Response

3. To the nearest dollar, the value of the final balance ***iii*** is $__________.
(Record your answer on the answer sheet.)

Answer: **4309**

Multiple-Choice and Numerical-Response Questions

Questions on the examination were grouped around real-life scenarios. The multiple-choice, numerical, and written-response questions were mixed within the scenarios of the exam, and where applicable, questions from the same unit of the course were organized together. Teachers involved in marking and item-writing sessions over the past year stated that the mixing of questions by types and units posed very few problems for students and requested that this format continue to be used. It was felt that the embedding of written-response questions within scenarios enhanced the opportunity for student success. A discussion of how well students met the curriculum standards in the units Quadratic Functions and Equations, Annuities, Mortgages, and Loans, and Radicals and Exponents follows.

Annuities, Mortgages, and Loans — In the Annuities, Mortgages, and Loans unit, students who achieve the standards can apply the concepts of ratio, rate, percentage, and proportion to annuities, loans, and mortgages. Multiple-choice questions 1 to 3 and numerical-response questions 2 and 3 were embedded in a consumerism scenario and required students to demonstrate their understanding in this unit. In addition, multiple-choice question 23, which was related to loans, was embedded in an Alberta industry scenario.

Multiple-choice questions 2 and 23, which required students to use tables, showed good results overall. Approximately 71.3% and 69.4% respectively, of all students who wrote the examination met the expectations for these questions.

Multiple-choice question 3 asked students to analyze a form similar to a spreadsheet and then apply a determined rate of interest to an annuity question. About 96.8% of all students who wrote the examination met the expectations of this question. However, in numerical-response question 3, when students were required to analyze the information presented in the (spreadsheet) chart further in order to determine a final amount, only 54.5% of all students could so do. Of the students who achieved the acceptable standard but not the standard of excellence, about 56.0% met the expectation for this question. Of the students meeting the standard of excellence, 74.4% were able to meet the expectation. Only 37.4% of students not achieving the acceptable standard were able to meet the expectation of this question. When required to do a more complex analysis and work task, students fell short. Students preparing for a diploma examination should ensure that they have a good understanding of concepts related to annuities, mortgages, and loans in order to be successful.

The camp director charges $2.00 for a bundle of firewood and sells 24 bundles per day. He finds that each time he increases the price by another 25¢ per bundle, he sells one less bundle per day.

A quadratic equation can be used to determine an expression for the maximum income the camp director could earn if the price is increased.

Let I = income
Let n = number of increases

I = number of bundles × price/bundle
$I = (24 - n)(2.00 + 0.25n)$
$I = 48 + 4n - 0.25n^2$
$I = -0.25n^2 + 4n + 48$

An equivalent expression in the form
$y = a(x - h)^2 + k$ is
$I = -0.25(n - 8)^2 + k$

Therefore, the maximum income in dollars is $\underline{\ i\ }$, and this occurs when the number of increases is $\underline{\ ii\ }$.

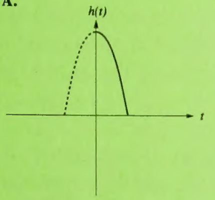
32. Which row on the chart shows the correct values of i and ii?

Row	i	ii
•A.	k	8
B.	8	k
C.	n	48
D.	48	n

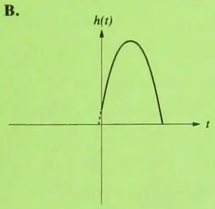
Bobby observed that an arrow shot during an archery session followed a parabolic path for which the height is approximated by the quadratic function $h(t) = -5(t - 1.4)^2 + 11$, where $h(t)$ is the height in metres and t is the time in seconds.

36. The graph that best represents this function for the positive values of t is

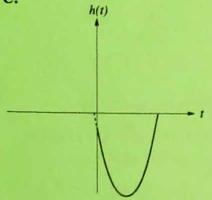
A.



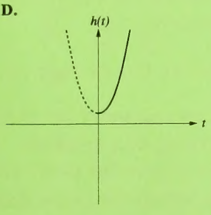
• B.



C.



D.



Quadratic Functions and Equations — To achieve the curriculum standards for quadratic functions and equations, students should be able to connect variables and equations to graphical representations of quadratic functions that model real-world contexts. Multiple-choice questions 32, 36, and 37 ask students to demonstrate this. In multiple-choice question 32, about 40.5% of all students who wrote the examination met the expectation for this question. About 39.6% of the students who achieved the acceptable standard but not the standard of excellence on the examination were able to achieve the expectation for multiple-choice question 32. Of the students who were not able to achieve the acceptable standard, only 23.7% were able to meet the expectation. For students who met the standard of excellence, 67.9% were able to demonstrate the expectation. Quadratics has been an area of weakness for some Mathematics 33 students in the field-test program over the past year and now continue to be so on the diploma examination. Students should expect continued emphasis on quadratics on upcoming examinations and should prepare for both machine-scored and written-response questions.

Multiple-choice question 36 also discriminated students' ability to apply quadratics. Question 36 was easier for students than was question 32, as 63.2% of all students who wrote the examination met the expectation for this question. About 65.6% of the students who achieved the acceptable standard but not the standard of excellence achieved the expectation. Of the students meeting the standard of excellence on the diploma examination, 86.2% were successful in meeting the expectations of this question, as compared with students not meeting the acceptable standard, of whom only 42.1% met the expectation.

Powers and Radicals – As a general outcome in Mathematics 33, students who achieve the standards can determine equivalent forms of radical expressions, and solve and verify radical equations.

Multiple-choice questions 13 through 17 and numerical-response questions 8, 9, and 11 tested these general outcome objectives. Multiple-choice questions 13, 14, 15, and numerical-response question 8 tested the radical operations of addition, subtraction, and multiplication.

The percentages of students who achieved the acceptable standard and correctly answered questions 13, 14, and 15 were 82%, 75%, and 85%, respectively; and 80% correctly answered numerical-response question 8.

However, only 44% of students who achieved the acceptable standard met the expectation for question 16, which asked students to simplify an expression that had a radical denominator.

Michelle connected procedures used to solve other equations to help her solve radical equations.

Numerical Response

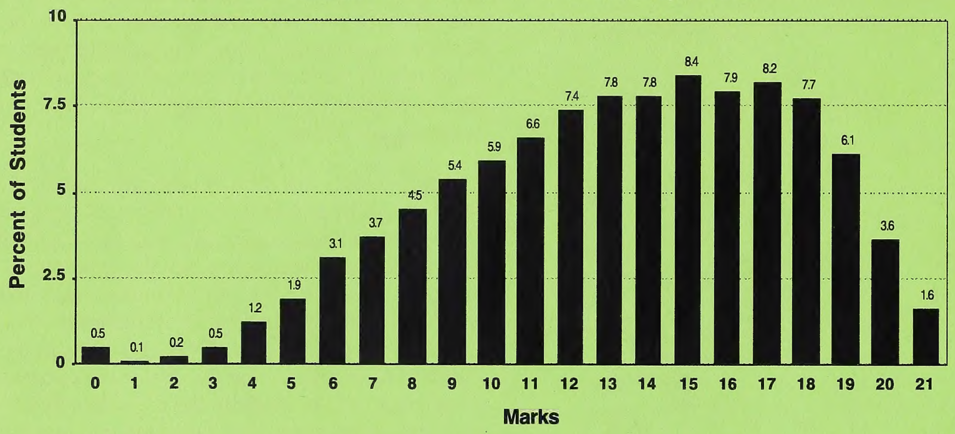
9. To the nearest tenth, the solution of $\sqrt{2x-3} - 5 = -3$ is $x =$ __________.
(Record your answer on the answer sheet.)

Answer: **3.5**

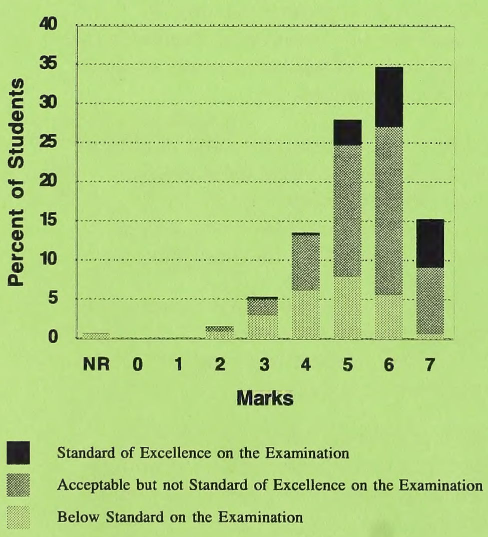
Numerical-response question 9 required students to solve a radical equation. Of the students who achieved the acceptable standard, 68.5% met this expectation. Students demonstrated basic skills in the radical unit but need to do better on multi-tasked and higher level problem-solving skills. An example of this is numerical-response question 11 which required students to apply equation and problem-solving skills. Numerical-response 11 had a difficulty level of 44.5%.

Written-Response Questions

The chart below shows the percentage of students achieving various marks on the written-response questions. The maximum mark obtainable was 21. Questions in the written-response section dealt with four of the seven content strands for Mathematics 33. Students achieving the acceptable standard were expected to obtain at least half marks on all questions. Students achieving the standard of excellence were expected to get almost full marks.



Distribution of Marks for Written Response



Distribution of Marks for Question 1

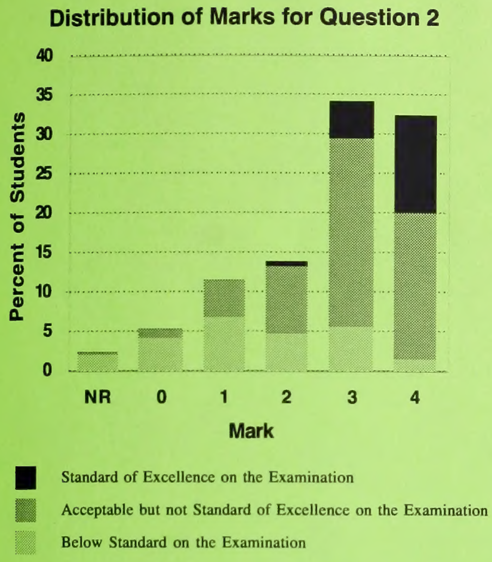
Question 1 required students to graph bivariate data from a table of values, interpret changes in the data including real-world causes, write a generalization using statistical information, and analyze and compare two sets of graphical data. This question was marked using an analytic scoring guide with holistic subparts. Part a was scored out of two marks, part b out of three marks; parts c and d were each worth one mark. Students who achieve the acceptable standard were expected to score at least 4 out of the 7 marks available. Of these students, 95.8% received either 4, 5, 6, or 7 marks on this question. Students who achieved the standard of excellence were expected to score 6 or 7 marks on this question. Of the students who achieved the standard of excellence, 78.9% achieved this expectation.

On this 7-mark question, the average mark was 5.32 or 76%.

Markers were asked to comment on student strengths and weaknesses in answering this question. In terms of strengths, markers reported that points for the first graph were located accurately and the comparisons articulated were done very well. Markers reported that there were very few "NR" (no response) papers and that students appeared to be off to a good start on the examination with this question.

The markers reported that students were poor in identifying and communicating a time span for increasing and decreasing energy consumption. As well, many student responses left the marker to infer a specific answer from one that was too general. These responses needed to provide more detailed support for statements made.

For part c of the question, it was evident from responses that there was some difficulty in using and understanding the meaning of box plots.

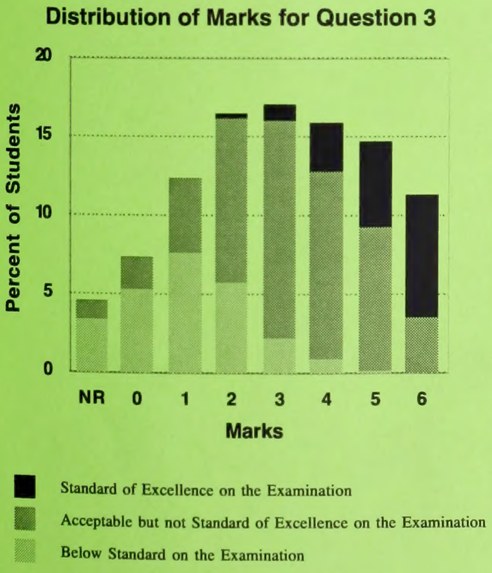


Question 2 required students to convert a radical expression to simplest radical form, and then explain the difference in accuracy between the answer in radical form and the decimal form obtained from a calculator. This question was marked holistically. Students who achieved the acceptable standard were expected to score at least 2 out of the 4 marks available. Of these students, 91.6% received either 2, 3, or 4 marks on this question. Students who achieved the standard of excellence were expected to score 4 marks on this question. Of the students who achieved the standard of excellence, 69.7% achieved this expectation.

On this 4-mark question, the average mark was 2.71 or 68%.

The teachers marking this question reported that generally responses showed understanding of the process of changing entire to mixed radical form, but sometimes showed an inability to do addition and subtraction operations. A general strength in responses was the fact that most students started the question and attempted an explanation. Overall, responses indicated most students were able to answer this question with ease.

A weakness in some responses was that students were unable to communicate their answer well and made numerous spelling errors. Some responses showed a lack of understanding in regards to a radical being an exact value as opposed to the decimal approximation obtained when using a calculator. Other responses showed a failure to recognize $3\sqrt{2}$ as being different from $\sqrt[3]{2}$, or $3\sqrt{2} - 7\sqrt{3}$ as being one value.



Question 3 required students to explain the connection between a problem and the rational equation developed to solve it, to state the non-permissible values of *x* for the equation, to use the quadratic formula to solve the problem, and to explain why only one of the answers obtained is the correct solution.

This question was marked using an analytic scoring guide with holistic sub-parts. Parts a and c were scored out of two marks, parts b and d were scored out of one mark.

Students who achieved the acceptable standard were expected to score at least 3 out of the 6 marks available. Of these students, 55.8% received either 3, 4, 5, or 6 marks on this question.

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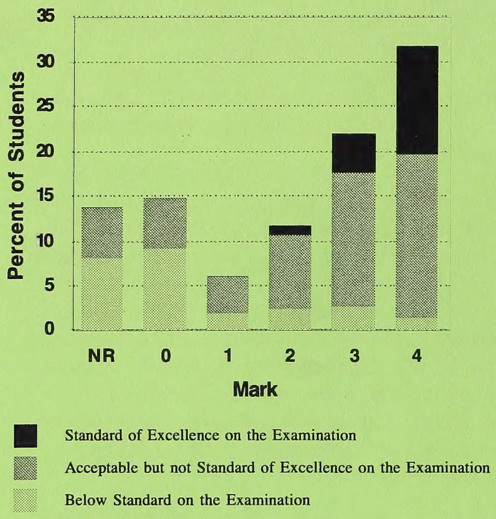
Students who achieved the standard of excellence were expected to score 5 or 6 marks on this question. Of the students who achieved the standard of excellence, 75.1% achieved this expectation.

On this 6-mark question, the average mark was 3.02 or 50%.

Generally, this question was well done, and the responses showed students' strengths in finding alternative strategies to a solution. For example, some responses showed strength in guess and check methods. Students who were unable to use the quadratic formula showed strength in determining the solution by factoring. However, too many students factored instead of using the formula as the question asked. Markers also reported weaknesses in the reasonableness of some of the responses, a lack of understanding of non-permissible values, misuse of units such as minutes and seconds, and carelessness in the use of negative signs. As a final comment related to question 3 and other questions on the examination, students need to become more familiar with directing words such as "explain." Markers indicated that some students did not give a rationale or explanation for their answer, yet filled the space provided.

Distribution of Marks for Question 4



Question 4 required students to solve a problem involving the use of trigonometry with two right triangles in three dimensions. This question was marked holistically. Students who achieved the acceptable standard were expected to score at least 2 out of the 4 marks available. Of these students, 58.8% received either 2, 3, or 4 marks on this question. Students who achieved the standard of excellence were expected to score 4 marks on this question. Of the students who achieved the standard of excellence, 67.8% achieved this expectation.

On this 4-mark question, the average mark was 2.2 or 56%.

Markers reported that, in general, students showed clear and complete problem-solving steps and included units in a concluding statement for their solution. They also noted that most students showed good use of calculators, although some failed to set their calculator in degree mode. Students who used the sine law tended to have more consistently correct solutions, because some students using the basic trigonometric functions chose the incorrect side as the hypotenuse or used incorrect ratios.

Weaknesses of students responses included communication and syntax errors, especially improper use of equal signs; improper rounding, including rounding at every step instead of only at the end; and poor layout of work, such as not following conventional direction of left to right and top to bottom for their steps.

Markers questioned whether student responses suggested poor time management. Question 4 was on the last page of the exam and there were over two times as many NR (no response) on this written-response question than on any of the previous three.

For further information, contact Ron Flaig (rflaig@edc.gov.ab.ca) or Phill Campbell (pcampbell@edc.gov.ab.ca) at the Student Evaluation Branch at 427-0010. To call toll-free from outside of Edmonton, dial 310-0000.

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